

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

JP pub 2001-054595

## \* NOTICES \*

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

---

## DETAILED DESCRIPTION

---

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] Especially this invention relates to the material of a head with respect to a golf club.

[0002]

[Problem(s) to be Solved by the Invention] In a golf club, one of the meanses for making large sweet area, i.e., the field to which the ball hit in the face often flies comparatively straightly, is enlarging the head itself. In recent years, the head on which volume exceeds 300 cc at wood crab has also appeared. For securing user-friendliness, even if it enlarges a head, since the AUW of a head must be suppressed, it cannot but make a head hollow and cannot but carry out the thinning of the coat. However, if the thinning of the coat is carried out, the intensity of a head will become weak, and there is a possibility that a head may be damaged by the shock at the time of the blow of a ball etc. Especially the face section by which a ball is hit needs to secure intensity, and, as for the board thickness of the face section, about 3.0mm has become the limitation of a minimum conventionally.

[0003] Moreover, a head with a golf club head made from titanium or a titanium alloy to which in recent years is becoming in use. A titanium alloy is light compared with stainless steel, and it is possible the increase of the flexibility of a design and to manufacture a bigger head compared with the head made from stainless steel generally moreover, since intensity is high. Thereby, sweet area spreads as mentioned above and the stable hit ball comes to be obtained.

[0004] Conventionally, as what is used as a material of a golf club head in the titanium alloy, there are beta type alloys, such as alpha+beta type alloys, such as Ti-6aluminum-4V alloy and a Ti-4.5aluminum-3V-2Fe-2Mo alloy, and a Ti-15V-3Cr-3Sn-3aluminum alloy, etc. Most Ti-6aluminum-4V alloys in various fields are used in the titanium alloy. However, since it ~~cannot cold-work~~, in order to manufacture a board with a thickness of 1-5mm generally demanded as a charge of head material, this alloy requires very many efforts and needs great cost. Therefore, the head made from Ti-6aluminum-4V alloy is manufactured by casting as indicated by JP,3-230845,A, for example. However, in order that titanium cannot be cast in the atmosphere since casting also tends to oxidize, and it may tend [ further ] to react with mold, it needs very advanced technology, and cost attaches it highly as a result. Since organization control cannot do a cast compared with rolling riser material in addition to it, it has the fault which becomes in intensity and weak. On the other hand, since a Ti-4.5aluminum-3V-2Fe-2Mo alloy can do superplasticity forming, it tends to obtain high intensity from a cast. However, even when performing superplasticity forming, in order to need special equipment and to require further much time, it is unsuitable for mass production method. Meanwhile, many beta type alloys with good cold-working nature, such as Ti-15Mo-5Zr-3aluminum and Ti-15V-3Cr-3Sn-3aluminum, are used increasingly. After these alloys are heat-treated in order to consider as predetermined thickness by cold working and to carry out the purpose and solution treatment which take distortion of cold working, they are assembled by the golf club head.

[0005] However, although thinning with the much more face has come to be called for in recent years in

order to fly a ball to a distance more, the problem that the charge of golf club head material of intensity of beta type alloy manufactured according to the conventional process was inadequate, and a crack occurred by the shock at the time of the blow of a ball arose. If it is the conventional stock thickness 3mm or more, having become the shortage of intensity by the thinning not more than it will break to the ability to have borne in intensity, and it will be considered the cause of generating.

[0006] this invention tends to solve such a trouble and aims at offering the golf club which has the head excellent in endurance.

[0007]

[Means for Solving the Problem] The golf club of invention of a claim 1 makes the material of a head the metallic material whose degree of cold working is 15% or more of processing organization, in order to attain the aforementioned purpose.

[0008] By enlarging the degree of cold working, it can leave work hardening produced in cold working, and the proof stress of material and surface hardness improve.

[0009] The golf club of invention of a claim 2 makes the material of a head material which carried out direct aging of the cold-working material, in order to attain the aforementioned purpose.

[0010] The proof stress of material and surface hardness improve by aging. Moreover, if direct aging of the cold-working material is carried out without solution treatment, according to the effect of work hardening by cold working, and the effect that an aging deposit advances more quickly, long heat treatment time will not be required to obtain sufficient intensity, and a manufacturing cost will be held down.

[0011] The golf club of invention of a claim 3 makes the material of a head material which carried out direct aging of the cold-working material which consists of a beta single phase by the beta titanium alloy, in order to attain the aforementioned purpose.

[0012] The proof stress of material and surface hardness improve by aging. Moreover, if direct aging of the cold-working material is carried out without solution treatment, long heat treatment time will not be required to obtain sufficient intensity, and a manufacturing cost will be held down. Namely, although beta type alloy is a precipitation-hardening type alloy, alpha phase is deposited in beta Al-rich by performing an aging treatment and intensity is obtained. If a direct aging treatment is carried out without releasing distortion produced when processing the member which constitutes a head with cold rolling, a press, etc. by solution treatment. It becomes possible to leave work hardening at the low temperature of only aging in low temperature, without removing work hardening produced in cold working by solution treatment, while becoming possible to promote the deposit of alpha phase more as compared with the case where aging of the solution treatment riser material is carried out. By these things, if alpha phase is deposited from the state of beta phase where it does not recrystallize, high intensity can be obtained in a short time. Furthermore, if it is beta single phase, when there is neither a bilayer organization nor a weak organization, a crack will not arise at the time between the colds of press working of sheet metal between \*\*.

[0013] In the golf club of invention of a claim 2 or a claim 3, the aforementioned material finishes and carries out after [ cold working ] direct aging of the invention of a claim 4 to beta single phase with hot rolling.

[0014] Thereby, it can manufacture by the low cost.

[0015]

[The operation form of invention] Hereafter, the operation form of the golf club of this invention is explained, referring to a drawing. Drawing 1 and drawing 2 show an example of the golf club with which this invention is applied. This golf club is wood club and a head 1 is the so-called metal wood in the air in metal. The back 3 and the bottom are making [ the side a tow 6 and else ] SOL 4, and crown 5 and the longitudinal-direction unilateral are making [ the face 2 and posterior to which, as for the head 1, a front face makes the blow side of a ball / the bottom ] the heel 7. The neck 8 is formed in this heel 7 bottom, and the hosel 9 has projected upwards from this neck 8. This hosel 9 makes the connection to which a shaft 10 is connected. And a head 1 may fill up this centrum 11 with fillers, such as polyurethane, although the interior is a centrum 11. Moreover, the score line 12 of the shape of two or

more concave is formed in the face 2.

[0016] And the aforementioned head 1 is trichotomized, for example and is constituted. namely, the coat section of a head 1 -- respectively -- the face of a tabular -- a member 16, the body part material 17, and crown -- it consists of a member 18 a face -- that in which a member 16 forms a face 2 -- it is -- crown -- a member 18 forms crown 5 and the body part material 17 forms the other back 3 and other SOL 4 and these faces -- a member 16, the body part material 17, and crown -- the member 18 of each other is joined by meanses, such as welding In addition, not restricting to an above-mentioned thing, dividing into two at a face 2 and back 3 side, and dividing more than quadrissection etc. may carry out division of a head 1.

[0017] Although it will become easy to produce a crack by the shock at the time of a blow if the thinning of the head 1 was carried out when the conventional material is used as mentioned above, when the crack section was investigated, from not the crack from the place considered to be inadequate in intensity but score line 12 partes basilaris ossis occipitalis, such as a weld zone, the crack arose, it spread on the face whole [ 2 ], and the crack and the bird clapper were found out. The generating situation of the score line 12 and its crack 21 is shown in drawing 3 . Furthermore, the inclination which a crack generates made clear what is mainly seen by score line 12 pars basilaris ossis occipitalis of the center of a face 2. When this was analyzed in material strength, load about 1t or more was added at the time of the blow of a ball, by this, the face whole [ 2 ] curved to the head 1 interior with the shortage of intensity, the stress generated at this time concentrated on score line 21 pars basilaris ossis occipitalis, and it became clear that a crack carries out generating progress by this. And in order to have prevented this phenomenon, in the field of material, it turns out that it improves [ the improvement in proof stress and ] in surface hardness. The improvement in proof stress compensates the shortage of intensity of the face 2 section which became thin, and prevents a curve into the head 1 of the face 2 at the time of the blow of a ball. The improvement in surface hardness prevents local deformation of the hit ball-ed section, and is effective in distributing more the stress concentration to score line 12 pars basilaris ossis occipitalis near [ by this ] the hit ball-ed section on the outskirts. Furthermore, the own defatigation property of material also raises the improvement in the proper proof stress within the limits which do not stiffen to a convenient thing, and an effect is in crack 21 prevention.

[0018] in order to make the analysis result in respect of [ material ] the above reflect in a material property, as a result of repeating various experiments, in order to attain the purpose, using the conventional manufacturing installation effectively, the proof stress and surface hardness which give the optimal aging treatment for the face 2 section, and a crack does not generate must be obtained -- understanding -- thin -- the optimal material property of the face 2 \*\*\*\* section has been grasped The aging conditions for on the other hand obtaining proof stress higher than before needed very long heat treatment time, and the new problem of raising a manufacturing cost sharply produced them. As a result of inquiring in order to solve this new problem, by carrying out direct aging, without carrying out solution treatment of the golf club head which it finished processing to \*\*\*\*\*, the above-mentioned problem could be solved and the golf club head excellent in endurance made from a titanium alloy was able to be obtained.

[0019] namely, the members 16, 17, and 18 from which the golf club of this invention constitutes a head 1 -- especially -- a face -- the material which carried out direct aging of cold-working material, especially the cold-working material which consists of a beta single phase by the beta titanium alloy as a material of a member 16, and the metallic material whose degree of cold working is 15% or more of processing organization are used further

[0020] As mentioned above, conventionally, a beta titanium alloy is an aging organization from a recrystallization state fundamentally, and is used for the face material of a golf club head. However, in this conventional method, in order to obtain the intensity of the grade which is a uniform organization comparatively, prolonged aging (it is about 8 hours at 500 degrees C) in comparatively high temperature must be given (all aging). even if a degree of hardness becomes high too much extremely and it is a uniform organization, when a uniform organization is obtained, although it is also possible to obtain a still more uniform aging organization by carrying out aging at the temperature of about 400-450 degrees

C for several 10 hours -- ductility -- above all -- the toughness under notching existence -- very --  
 \*\*\*\*\* -- it becomes the quality of the material

[0021] moreover, low-temperature aging -- be -- artificial aging -- be -- the priority deposit of alpha phase to a grain boundary is unescapable, and sufficient toughness for thinning is not acquired but checks endurance

[0022] By on the other hand, promotion of alpha phase deposit across which alpha phase comes to deposit [ the inside of a grain boundary and a grain ] promptly almost to the same extent by suppressing the priority deposit of alpha phase to the grain community which deposits alpha phase from a non-recrystallized structure, and it goes throughout this Even if it does not carry out aging until it will be in a perfect aging state, a uniform organization is obtained, and when alpha phase is not deposited completely and \*\* is also made to reach by a certain amount of intensity, high ductility and high toughness are maintained. although even the several % (skin-pass rolling grade) degree of cold working is demonstrated, more preferably, by 15% or more of workability, endurance is boiled markedly and this effect's improves

[0023] Furthermore, if beta particle size in beta phase is made fine as known from the former, a good property will be acquired in ductility.

[0024] By this invention, the titanium-alloy organization before aging was made into beta single phase for a crack arising to the member which constitutes a head 1, between the colds in case press working of sheet metal between \*\* is carried out, when weak organizations, such as a two phase organization of alpha+beta and an omega phase, existed.

[0025] Moreover, material in front of aging was considered as the cold-working organization for obtaining intensity sufficient at the time of aging of the last head 1. In the organization which did not a cold-working organization but solution treatment, intensity sufficient by short-time aging is not obtained, but there is a possibility that a crack etc. may arise by the shock at the time of the blow of a ball. Furthermore, this effect can attain enough by making the degree of cold working 15% or more.

[0026] Furthermore, a direct aging treatment is carried out for obtaining higher intensity by carrying out direct aging of the head 1, without carrying out solution treatment in heat treatment of a head 1.

[0027] Thus, high intensity can be obtained by carrying out aging, without producing and carrying out solution treatment of the head 1 with the material which has a cold-working organization. Although beta type alloy is a precipitation-hardening type alloy, alpha phase is deposited in beta Al-rich by performing an aging treatment and intensity is obtained If a direct aging treatment is carried out without releasing distortion produced when processing the member which constitutes a head 1 with cold rolling, a press, etc. by solution treatment It becomes possible to leave work hardening at the low temperature of only aging in low temperature, without removing work hardening produced in cold working by solution treatment, while becoming possible to promote the deposit of alpha phase more as compared with the case where aging of the solution treatment riser material is carried out. And intensity higher than before can be obtained according to these two effects in a short time.

[0028] Although intensity also with a high material by the conventional process can be obtained, it is necessary for that to perform an aging treatment for a long time, and faults, such as an increase in a manufacturing cost and a fall of productivity, arise. Therefore, this cannot serve as realistic correspondence for solving a technical problem easily.

[0029] In an example of the manufacture method of the golf club of this invention The plate of predetermined board thickness is created by performing hot rolling and cold rolling after producing an ingot by arc welding from the charge of an alloy of necessary composition. The members (the aforementioned face a member 16, the body part material 17, and crown member 18 etc.) which pressed this plate between cold pressing or \*\*, and were equipped with the required configuration are produced. They are joined by welding, a head 1 is produced, the aging treatment of the obtained head 1 is carried out, and a golf club is produced by attaching the head 1 obtained by this to a shaft 10, and assembling it.

[0030] However, it is necessary to pay attention first to hot rolling for effective operation of this invention. With hot rolling, when phases other than beta phase deposit, it is necessary to carry out solution treatment after that. This is required in order to perform subsequent cold working satisfactory.

However, if possible, it can manufacture by the low cost by carrying out a temperature control so that it may be finished in beta single phase with hot rolling. Even if it does not perform subsequent cold working enough by making it generate distortion at the time of hot rolling in addition to it, work hardening is fully obtained and it can manufacture by the low cost further. Moreover, cold working also takes cautions. Since after [ the last processing ] solution treatment is carried out by the conventional method, it is also possible to apply heat there and to correct a configuration simultaneously. On the other hand, with the operation gestalt which does not perform solution treatment after cold working in this invention, since such reform is not performed, it is necessary to acquire configuration sufficient by cold working beforehand.

[0031] Furthermore, it needs to be cautious also of hydrogen absorption. That is, generally, a beta titanium alloy needs to carry out elevated-temperature heat treatment in a vacuum or Ar atmosphere, when it is easy to cause hydrogen absorption and hydrogen absorption takes place. At the conventional process, in order for difficulty to follow on it, it is necessary to pay attention with the method of this invention, although it is possible to perform a dehydrogenation by solution treatment so that hydrogen absorption may not be carried out in the middle of a process. Since especially a pickling process is a process which hydrogen absorption tends to produce, it is necessary to manage pickling liquid (for example, fluoric acid + nitric-acid solution), pickling temperature, pickling time, etc.

[0032]

[Example]

[Table 1]

| 加工条件             | 時刻条件      | 硬さ:HV1.0 | 耐力(N/mm <sup>2</sup> ) | 備考    |
|------------------|-----------|----------|------------------------|-------|
| 溶体化上がり材          | 450°C×8時間 | 341      | 997                    | 比較例 1 |
| 溶体化+10%冷間加工      | 450°C×8時間 | 357      | 1038                   | 実施例 1 |
| 溶体化+15%冷間加工      | 450°C×8時間 | 393      | 1179                   | 実施例 2 |
| 溶体化+30%冷間加工      | 450°C×8時間 | 415      | 1244                   | 実施例 3 |
| 溶体化+50%冷間加工      | 450°C×8時間 | 450      | 1387                   | 実施例 4 |
| 熱間上がり+直接 30%冷間加工 | 450°C×8時間 | 427      | 1262                   | 実施例 5 |

[0033] Table 1 shows the measurement result of the hardness and proof stress after aging of various material. After [ hot rolling ] solution treatment of the Ti-15V-3Cr-3Sn-3aluminum alloy which is beta type alloy is carried out in more detail, the aging treatment of the material which does not cold-roll it, and the cold-rolled material is carried out, respectively, and change of hardness is investigated. Aging-treatment conditions are 450 degree-Cx 8 hours. Even if it heat-treats the material which carried out after [ hot rolling ] solution treatment for 450 degree-Cx 8 hours, when hardness carries out aging of the material which cold-worked it on the same conditions to remaining about in 341, it is understood that hardness rises further. This is because the effect of work hardening by cold working and the effect that an aging deposit advanced more quickly showed up. Moreover, if especially the degree of cold working becomes 15% or more, the effect will show up clearly. Furthermore, when it did not solution-ize, but it cold-rolled directly after hot rolling and the aging treatment was performed, hardness made the bird

clapper clear highly further. Although this example was 450 degrees C in aging temperature, it was checked that there is an effect with lower 400 degrees C or at least same 300 degrees C. Furthermore, at the temperature of 600 degrees C or more, although the effect even with the same temperature of 450 degrees C or more is acquired, since aging does not progress, and distortion is removed or recrystallization arises, there is a possibility that an effect may fade. That is, aging temperature has desirable about 300-600 degrees C.

[0034]

[Table 2]

| フェース部材の種類 | 板厚(mm) | 熱処理    | 割れまでの試打回数        | 備考    |
|-----------|--------|--------|------------------|-------|
| 30%冷間圧延材  | 2.7    | 時効     | 5000 回以上試打後も割れなし | 実施例 6 |
| 50%冷間圧延材  | 2.7    | 時効     | 5000 回以上試打後も割れなし | 実施例 7 |
| 30%冷間圧延材  | 2.7    | 溶体化+時効 | 3200 回           | 比較例 2 |
| 0%冷間圧延材   | 2.7    | 溶体化    | 2500 回           | 比較例 3 |
| 熱間上がり材    | 2.7    | 溶体化+時効 | 2700 回           | 比較例 4 |
| 熱間上がり材    | 2.7    | 溶体化    | 1000 回           | 比較例 5 |

条件：ヘッドスピード 48m/秒

ヘッド容量 300cc

フェース板厚 t1 2.7mm、

時効条件 400℃×8 時間

フェース板厚 t2 1.15mm、クラウン板厚 t3 1mm

[0035] The result which investigated the endurance of the head 1 created with the Ti-15V-3Cr-3Sn-3aluminum alloy of this example is shown in Table 2. Real \*\*\*\*\* for golf is used for this. Neither



with what used solution-ized riser material for the face 2 of a head 1, nor the material which performed the aging treatment after solution treatment, a crack, a depression, etc. are generated on a face 2 at the time of test forming, and the good result is obtained. However, using cold rolling, also in the stage which performed 5000 times of test forming, neither the crack nor the hollow was accepted but the good result was obtained at this example made into the aging treatment.

[0036] the board thickness  $t_1$  of the face 2 section -- 2.7mm and titanium material -- the former -- there is nothing -- thin -- carrying out -- the face -- by the case where it does not consider as the case where this invention is applied to a member 16, it is divided clearly, the number of times of test forming to generating differs, and it is proved by this example that especially this invention is effective as a golf driver

[0037] In addition, this invention is not limited to the aforementioned example and various deformation implementation is possible for it. For example, although the aforementioned example took and explained the beta titanium alloy to the example, this invention is effective in alpha titanium, stainless steel, etc. Furthermore, in the aforementioned example, although wood crab was taken for the example, this invention is applicable to iron crab etc.

[0038]

[Effect of the Invention] A head can be enlarged suppressing AUW by the ability raising the endurance of a head, therefore making stock thickness of a head thin, since the degree of cold working made the material of a head the metallic material which is 15% or more of processing organization according to the golf club of invention of a claim 1, and the golf club which is easy to use can be offered.

[0039] A head can be enlarged suppressing AUW by the ability raising the endurance of a head, therefore making stock thickness of a head thin, holding down a manufacturing cost, since material which carried out direct aging of the cold-working material was made into the material of a head according to the golf club of invention of a claim 2, and the golf club which is easy to use can be offered.

[0040] A head can be enlarged suppressing AUW by the ability raising the endurance of a head, therefore making stock thickness of a head thin, holding down a manufacturing cost, since material which carried out direct aging of the cold-working material which consists of a beta single phase by the beta titanium alloy was made into the material of a head according to the golf club of invention of a claim 3, and the golf club which is easy to use can be offered.

[0041] Furthermore, according to the golf club of invention of a claim 4, since after [ cold working ] direct aging of the aforementioned material was finished and carried out to beta single phase with hot rolling, it can be manufactured by the low cost.

---

[Translation done.]